

# **Appendix N**

**U.S. Army Corps of Engineers**

**2008 TDG TMDL**

**Implementation Summary**



## **Introduction**

In September 2002, the states of Oregon and Washington issued a Total Maximum Daily Load (TMDL) that addresses total dissolved gas (TDG) in the mainstem Columbia River from its confluence with the Snake River to its mouth at the Pacific Ocean. The states of Oregon and Washington have both listed multiple reaches of the Lower Columbia River on their federal Clean Water Act 303(d) lists, due to TDG levels exceeding state water quality standards. The entire reach is considered impaired for TDG. Oregon and Washington jointly issued the TMDL and submitted it to the U.S. Environmental Protection Agency (EPA) for its approval.

In August 2003, the State of Washington issued a TMDL that addresses TDG in the mainstem Snake River from its confluence with the Clearwater River to its mouth at the Columbia River. Washington has listed multiple reaches of the Lower Snake River on its federal Clean Water Act 303 (d) list due to TDG levels exceeding state water quality standards. The entire reach is considered impaired for TDG. Washington issued the TMDL and submitting it to the EPA for its approval. EPA approved the Lower Snake TDG TMDL on September 30, 2003.

Elevated TDG levels are caused by spill events at four hydroelectric projects on the Lower Columbia River (McNary, John Day, The Dalles and Bonneville) and the four hydroelectric projects on the Lower Snake River (Lower Granite, Little Goose, Lower Monumental and Ice Harbor). Water plunging from a spill entrains TDG at high levels. High TDG can cause “gas bubble trauma” in fish, which can cause chronic or acute effects, depending on TDG levels. Spills can be caused by several conditions. “Voluntary” spills are provided to meet juvenile fish passage goals. “Involuntary” spills are caused by lack of powerhouse capacity for river flows. Involuntary spills can result from turbine maintenance or break-down, lack of power load demand, or high flows due to runoff events. Elevated TDG levels also enter the TMDL area at the upstream boundary from sources outside the TMDL area.

The TMDL sets a TDG loading capacity for the Lower Columbia and Snake River in terms of excess pressure above ambient. Allocations are specified for each dam and for the upstream boundary, also expressed in terms of excess pressure. Allocations for the dams must be met at points of compliance within each dam’s tailrace at a specified distance below the spillway, corresponding to the end of the aerated zone. The upstream allocation must be met in the pool above McNary dam.

An implementation plan was provided that describes short-term actions for Endangered Species Act (ESA) requirements. Long-term actions are described for meeting responsibilities for both the ESA and the TMDL.

The summary implementation strategy (SIS) incorporates actions described and analyzed by the NOAA Fisheries in the 2000 and 2004 Biological Opinions and by the Corps in the Dissolved Gas Abatement Study (DGAS). Both short-term (Phase I) and long-term (Phase II) measures are described with specific TDG and spill reduction measures. Phase I is in

effect through 2010. Phase II begins in 2011 and continues through 2020. The TMDL summary implementation actions listed in this appendix have been and include specific measures that were included in the original TMDLs as well as additional measures that were not originally included. The SIS has been developed in consultation with NOAA Fisheries, so that TMDL implementation will be coordinated with requirements of the ESA. A more comprehensive plan to address TDG abatement strategies is incorporated in the 2008 Water Quality Plan (WQP) which will be available December 2008.

**The TMDL summary implementation Actions:**

The following summary tables provide an overview of the status of the short-term and long-term Corps TDG TMDL implementation activities recommended in the TDG TMDL's for the Lower Columbia River and the Lower Snake River.

Table N-1 provides the current status of the short-term TDG TMDL implementation actions. There are some actions in this table that were not included in the TDG TMDL original list but are being implemented on the hydrosystem, so they were included and have a "---" in the action item number. Table N-2 provides the operational implementation actions that can be taken to minimize TDG. Table N-3 provides the current status of the long-term TDG TMDL implementation activities.

**TABLE N-1**  
**SHORT TERM – PHASE I TMDL IMPLEMENTATION**  
**Structural Implementation Actions**

<b>2000 Biological Opinion Action Item Description</b>	<b>Action Item No.</b>	<b>Status</b>	<b>Actual/Estimated Completion Date</b>
Chief Joseph Deflectors	136	Construction of spill bay deflectors completed October 2008.	2009
Chief Joseph Deflectors	136	Post-deflector spill test to check TDG exchange properties during spillway discharges	2009
Lower Granite Removable Spillway Weir (RSW)	80	RSW construction completed.	2001
Lower Granite Removable Spillway Weir (RSW)	80	Testing of spring and summer migrants after RSW construction is complete.	2005
Little Goose Endbay Deflectors	134	Construction of deflectors in bay 1 and 8 completed	2009
Little Goose Endbay Deflectors	134	Evaluate and testing after Temporary Spillway Weir (TSW) installed which is scheduled for March 2009.	2010
Little Goose Spillway Divider Wall	135	Under evaluation.	Unknown
Lower Monumental Endbay Deflectors	134	Construction completed. Preliminary studies were completed.	2003
Lower Monumental Endbay Deflectors	134	Testing to occur after RSW installed. Testing began in 2008.	2009
Lower Monumental Bypass Outfall Relocation	76	Currently under evaluation.	2011
Ice Harbor Deflectors	134	Construction completed.	2002
McNary Endbay Deflectors	134	Deflectors construction completed.	2002
John Day Deflectors	134	Deflectors in bays 2 - 19 construction completed.	2002
John Day Endbay Deflectors	140	Endbays #1 and 20 - Not planned at this time.	Unknown
John Day Spillwall	135	No divider wall planned at this time.	Unknown
The Dalles Deflectors	134	Not planned at this time, spillway survival still under investigation.	N/A
The Dalles Spillwall	135	The first spillwall construction completed	2005
The Dalles Spillwall	135	Biological Evaluations after first spillwall was installed.	2006
The Dalles Spillwall	135	Construction of a larger and longer spillwall began in 2008.	2010
The Dalles Spillwall	135	Biological Evaluations after spillwall construction completed.	2012
The Dalles Turbine Intake Blocks	69	Construction of turbine intake blocks was completed.	2001
The Dalles Turbine Intake Blocks	70	Testing was performed and results showed that block hydraulics were harmful to fish. All were removed.	2004
The Dalles Sluiceway Outfall Relocation	70	Not being investigated at this time. Current sluiceway being used as is.	Unknown

**TABLE N-1 (Continued)**  
**SHORT TERM – PHASE I TMDL IMPLEMENTATION**  
**Structural Implementation Actions**

<b>2000 Biological Opinion Action Item Description</b>	<b>Action Item No.</b>	<b>Status</b>	<b>Actual/Estimated Completion Date</b>
Bonneville Endbay Deflectors	134	Deflectors construction completed.	2002
Bonneville Powerhouse 2 Corner Collector (B2CC)	66	Construction of corner collector in Powerhouse 2 completed.	2004
Bonneville Powerhouse 2 Behavioral Guidance System (BGS)	66	Behavioral Guidance System (BGS) for improved guidance for yearling and subyearling chinook to the B2CC construction completed.	2008
Bonneville Powerhouse 2 Fish Guidance Efficiency Improvement	67	Installing turning vanes on Submerged traveling screens (STS). Installing ceiling gap closure device.	1997
Bonneville Powerhouse 2 Fish Guidance Efficiency (FGE) Improvement	67	Decision Document Completed FY05 – FGE and in-take improvements. Modifying Vertical Barrier Screens (VBS).	2008
Bonneville Powerhouse 2 Fish Guidance Efficiency (FGE) Improvement	67	Biological Evaluations after new designed VBS. Gatewell evaluation results need retesting	2009
Bonneville Powerhouse 1 Surface Bypass or Extended Screens	61, 62	Biological evaluations completed but biological benefits were out weighted by cost, thus suspending progress.	Unknown
Bonneville sluiceway improvement study	---	Finished letter report for modification of B1 sluiceway chain gates.	2007
Bonneville spillway gate re-design	---	Bonneville spillway gate re-design of 18 gates began in 2008	2009
Bonneville sluiceway improvement	---	Remove the Juvenile Bypass System (JBS) channel.	2009
Bonneville sluiceway improvement	---	Construction of 3 automated sluiceway begin in 2008	2009
All Projects - Survival based spill caps at all dams (e.g. 40% at The Dalles).	68, 82	Studies are on-going	N/A

**TABLE N-2**  
**OPERATIONAL TMDL IMPLEMENTATION ACTIONS**

<b>Operational Action</b>	<b>Status</b>
Scheduling routine turbine maintenance and repair during low-power load and river flow periods.	On-going
Preventative maintenance of turbines to prevent breakdown.	On-going
System management of water release from upstream storage reservoirs to minimize involuntary spill at dams in the TMDL area.	On-going
Optimizing power purchasing to allow maximum use of powerhouse capacity and minimization of involuntary spill.	On-going
Testing various spill patterns to find the most effective on for fish passage and TDG production. If spill pattern produces undesirable results, modify spill pattern.	On-going

**TABLE N-3**  
**LONG TERM – PHASE II TMDL IMPLEMENTATION ACTIONS**

<b>2000 Biological Opinion Action Item Description</b>	<b>Status</b>	<b>Expected Completion Date</b>
Little Goose Temporary Spillway Weir (TSW)	Construction and Installing TSW planned for March 2009.	2009
Little Goose TSW	Evaluation and testing after TSW construction completed. Begins in 2009 and continues to 2011.	2011
Lower Monumental Removable Spillway Weir (RSW)	Construction completed.	2008
Lower Monumental RSW	Evaluation and testing after RSW construction completed. Began 2008 and continues 2009.	2009
Lower Monumental Extended Screens	Extended screens are suspended because of the cost to benefit ratio.	Unknown
Ice Harbor RSW	RSW construction completed.	2005
Ice Harbor RSW	Testing to occur after RSW installed. Testing began 2005.	2009
Ice Harbor Modernization, Turbine Runner Prototype.	Preliminary design underway.	2009
Ice Harbor Modernization, Turbine Runner Prototype.	Construction of Turbine Runner .	Unknown
McNary Temporary TSW	Construction of TSW completed on bays 20 and 22.	2007
McNary Temporary TSW	The TSWs are being moved to various bays to optimize for surface fish passage.	2009
McNary Temporary TSW	Biological testing after TSW construction is completed.	2009
McNary Modernization	Biological testing completed	2005
McNary Modernization, Turbine Runner Prototype.	Work design suspended	Unknown
McNary Bypass Improvements (outfall, temperature)	Bypass outfall may be relocated	2011
McNary Bypass Improvements (outfall, temperature)	Temperature improvements are currently being evaluated. No investigations concerning outfall improvements are on-going.	Unknown
John Day TSW	Construction of 2 TSWs completed in bays 15 and 16.	2008
John Day TSW	Biological testing after TSW construction is completed.	2009

**TABLE N-3 (Continued)**  
**LONG TERM – PHASE II TMDL IMPLEMENTATION ACTIONS**

<b>2000 Biological Opinion Action Item Description</b>	<b>Status</b>	<b>Expected Completion Date</b>
John Day Extended Screens	Tested and performed poorly, suspended.	2003
The Dalles predator removal program (allow access to fish Pike Minnow)	Ongoing removal program at Lower Columbia River dams. Ongoing - funded by BPA.	N/A
Bonneville Sea Lion Exclusion Device (SLED).	SLED devices were constructed and installed.	2007
Bonneville Powerhouse 1 Minimum Gap Runners	Construction of unit 10 planned for 2009.	2009
Bonneville Powerhouse 1 Minimum Gap Runners	Units 1,2,3,4,5,6,9 completed.	1990-2007
Bonneville Powerhouse 1 Minimum Gap Runners	Construction completed on Unit 7.	2007
Bonneville Powerhouse 1 Minimum Gap Runners	Construction completed on Unit 8.	2008
All Projects - Improved Operation and Maintenance	Ongoing	N/A
All Projects - Implement Turbine Survival Program Results	Ongoing	N/A
All Projects - Spill Effectiveness Studies	Ongoing, site specific as warranted.	Site specific